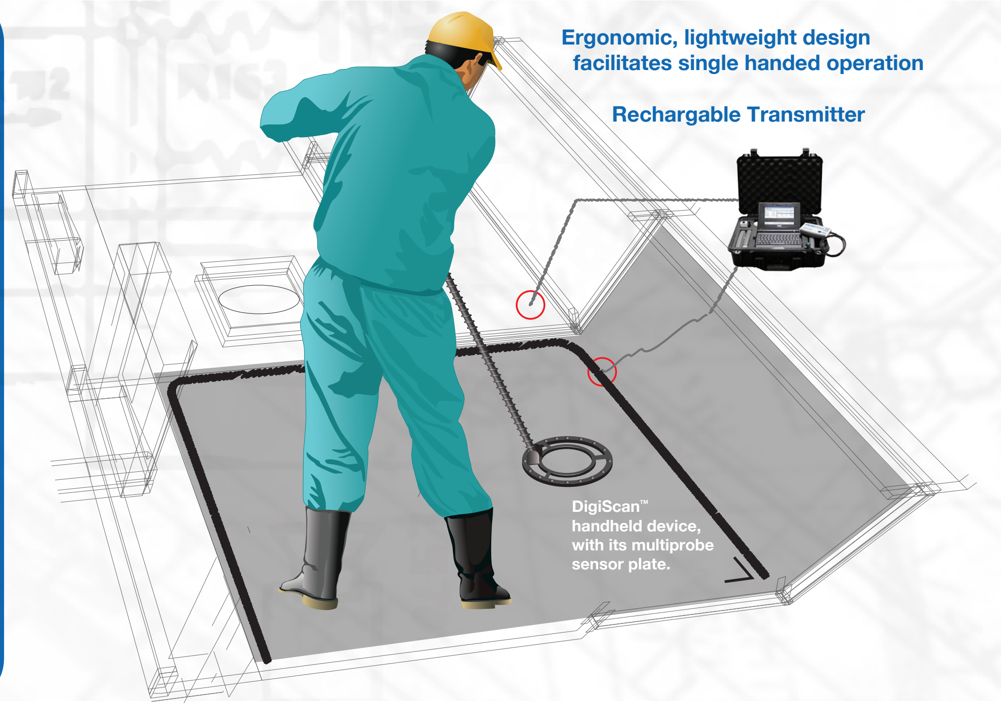
MEMBRANE SCANNING QUALITY ASSURANCE

The DigiScan™ 360° Service

The DigiScan™ 360° Service includes a comprehensive roof scan using the latest in digital multi-vector mapping technology. Using the revolutionary DigiScan™ handheld unit, even the smallest membrane breach can be located for repair.

The DigiScan™ handheld unit can be used on water proofing membranes and related construction detailing.



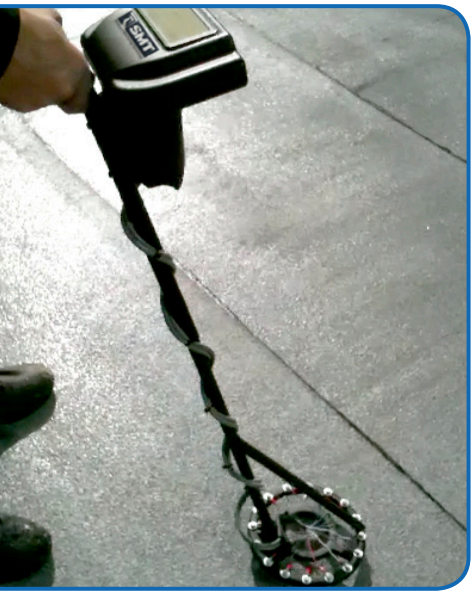
Ergonomic, lightweight design facilitates single handed operation

Rechargable Transmitter

DigiScan™ handheld device, with its multiprobe sensor plate.

1.218 V
12.500 V
SMT
Structure Monitoring Technology

DigiScan™ - Digital Interface



Multiprobe Sensor Plate

TURN PHYSICS INTO A RISK MITIGATION TOOL

Whether you are a designer, contractor, inspector or owner, you know that leak prevention is the best risk mitigation strategy. The DigiScan™ 360° Service guarantees complete peace of mind by locating pin point sized membrane intrusions before they turn into costly roof leaks.

Our experts recognize that the best way to expose hidden moisture intrusion points is to use the physics of electrical conductivity. A proactive DigiScan™ 360° Service using the DigiScan™ handheld unit is one of today's ready solutions, allowing you to apply physics as a risk mitigation tool.

EFFECTIVE

The DigiScan™ handheld unit is most effective on inverted and vegetative roof systems and also where the water proofing membrane is in contact with the concrete, metal or wood roof support system.

The DigiScan™ handheld unit can be utilized on existing or new membrane systems for quality assurance purposes during construction, or for the detection of leaks after overburden has been installed. The DigiScan™ 360° Service is non-destructive, non-invasive and does not require that the entire membrane installation be completed prior to starting the scan, such as in flood testing and other methods.

ADVANCED TECHNOLOGY. MADE SIMPLE.

The DigiScan™ 360° Service provides the latest in membrane scanning and water intrusion solutions to help protect you and your property. While no prior knowledge in electronics or electric fields is required to operate the DigiScan™ handheld unit, SMT provides comprehensive training to field technicians in the art and science of leak detection and prevention.

SIMPLE AS 1-2-3

In a blink of the eye the DigiScan™ handheld unit scans 360° to produce a vector indicating the flow of current towards a leak. The operator simply watches the LCD display and scans in the direction of the arrows until the precise location of the penetration is identified. The procedure is as follows:

1. Place a guard cable around the area to be scanned and connect to a rechargeable power source.
2. Gently spray the test area evenly with water to create a conductive medium.
3. Using the multi-probe sensor plate, the direction and severity of a membrane breach is displayed on an LCD interface.

Call us today to arrange your DigiScan™ 360° Service.

www.smtresearch.ca

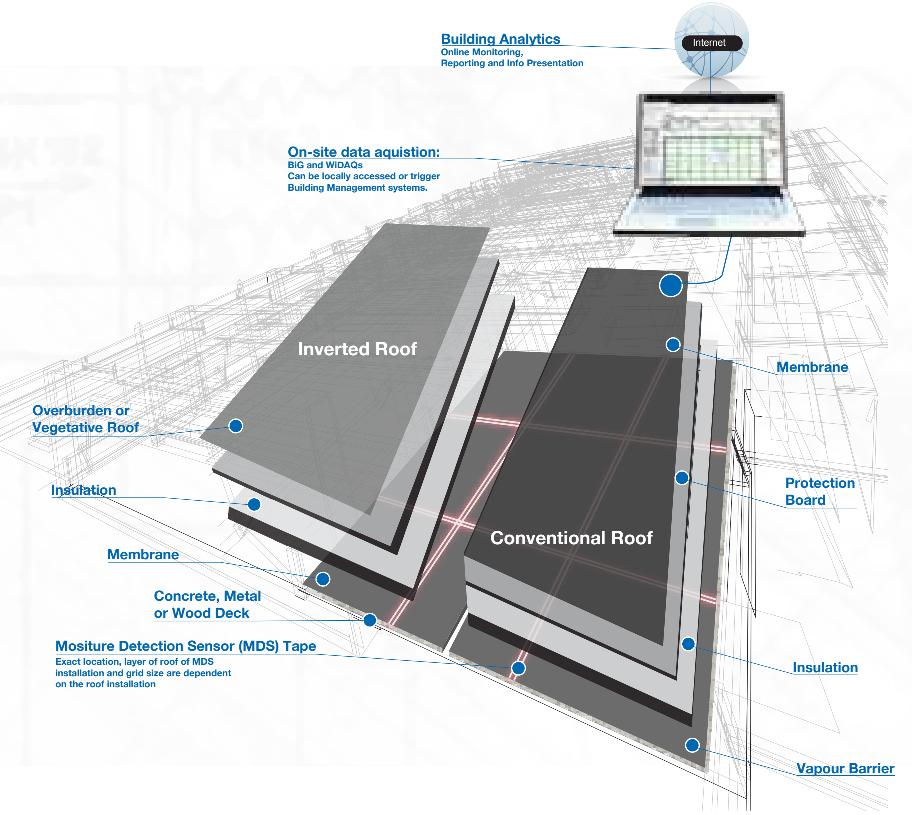
SMT

MEMBRANE MONITORING ASSET PROTECTION

BuildingIntelli™ Membrane Monitoring

Build intelligent monitoring right into your roof structure by installing a BuildingIntelli™ Membrane (BIM) monitoring system designed by SMT. The BIM monitoring system includes a comprehensive, continuous, permanently installed membrane integrity monitoring system. A BIM employs the latest in moisture detection sensors installed in a grid or in lengths to monitor for hidden moisture intrusions and membrane breaches.

The BIM monitoring system can be applied to conventional, inverted low slope and sloped roof systems with concrete, metal or wood roof support systems. Sensors can even be installed in existing structures for investigative purposes or for a sampling of building conditions.


Building Analytics
Online Monitoring, Reporting and Info Presentation
Internet
On-site data aquistion:
BiG and WiDAQs
Can be locally accessed or trigger Building Management systems.
Inverted Roof
Conventional Roof
Membrane
Overburden or Vegetative Roof
Insulation
Protection Board
Membrane
Concrete, Metal or Wood Deck
Mositure Detection Sensor (MDS) Tape
Exact location, layer of roof of MDS installation and grid size are dependent on the roof installation
Insulation
Vapour Barrier

Monitoring Grid on Inverted Roof

Monitoring Grid under Green Roof

Updated Status in Real Time

RISK MITIGATION AT YOUR FINGERTIPS

Whether you are a designer, contractor, inspector or owner, you know that leak prevention is the best risk mitigation strategy. Having a BIM monitoring system provides complete peace of mind by locating pin point sized membrane intrusions before they turn into costly roof leaks. Best of all, this assurance is provided for the lifespan of the building.

Our experts recognize that the best way to expose hidden moisture intrusion points is to use the physics of electrical conductivity. Your computer will display the status of the permanently installed BuildingInteli™ Membrane monitoring system, making it one of today's ready-to-use solutions for risk mitigation.

PEACE OF MIND

The BuildingInteli™ Membrane monitoring system works even when you are not. BIM monitoring system continuously measures the moisture status from the sensors, analyzes the data, and sends out appropriate notifications for action. Escalating alerts can be sent via e-mail, text pages or even directly to your building management or general alarm system.

Using proprietary SMT Building Analytics, the location of the leak or water event is shown on drawings or photos and may be accessed through any web connected device such as your computer or Smartphone

ADVANCED TECHNOLOGY. AVAILABLE TODAY.

BuildingInteli™ Membrane monitoring systems are the latest in membrane monitoring and water intrusion solutions to help protect you and your property. SMT utilizes proprietary, patent-pending wired and wireless systems to provide a cost effective monitoring solution based on your roof type, construction method and budget.

Get SMT involved in your project today. Based on your roofing system and project, SMT provides a comprehensive conceptual design and application guide to assist in the science of leak detection.

Contact us today to get started with the BuildingIntelli™ Membrane Monitoring System.

www.smtresearch.ca

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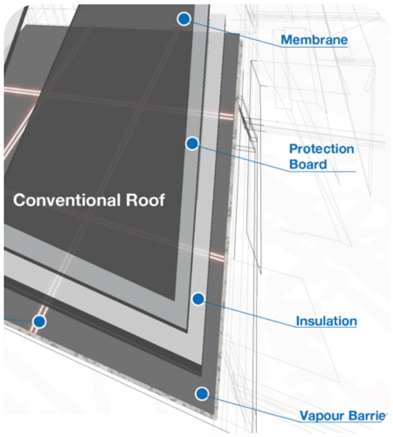
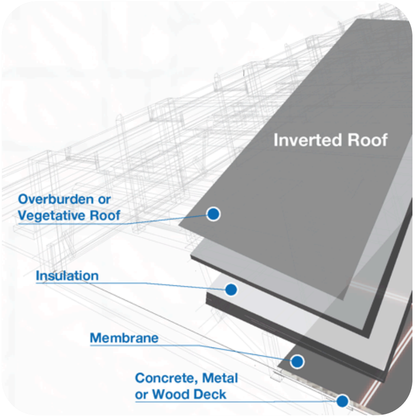
UNDERSTANDING THE APPLICATION OF MOISTURE DETECTION SYSTEMS TO ROOF AND WALL BUILDING ELEMENTS.

The application of a moisture detection system to roofing surfaces and materials is commonly referred to as, low-slope roof systems and falls broadly into two categories: Low-slope Conventional Roof and Low-slope Inverted Roof Systems. The application of moisture detection systems under sloped, shingled, or typical wood frame construction is not covered in this documentation.

The application of low-slope roof systems are typically found in commercial, institutional and multi-unit residential buildings where a flat roof over a larger floor plan is required. Typical Vegetative and Green roofs are installed over low-slope roof assemblies that comprise inverted or conventional roof sub systems based on building design, age, and structural purpose.


Membrane
Protection Board
Conventional Roof
Insulation
Vapour Barrie

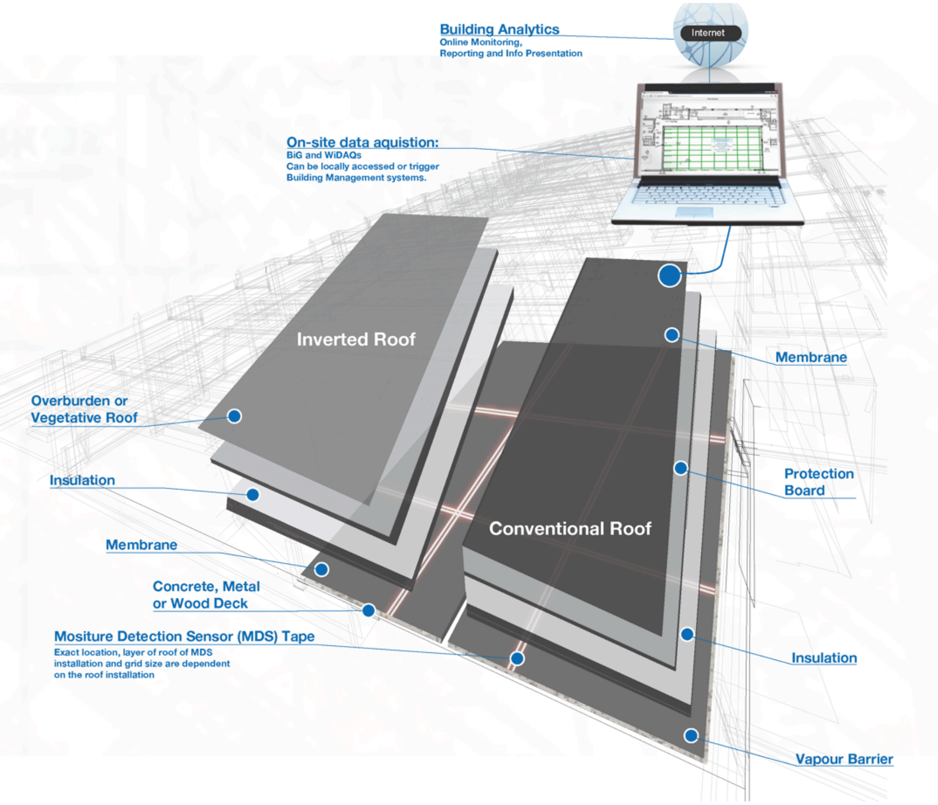

Inverted Roof
Overburden or Vegetative Roof
Insulation
Membrane
Concrete, Metal or Wood Deck

Conventional Roofs (Exposed membranes) have a roof lay-up of wood, metal, or concrete deck, with a vapor barrier and multiple layers of insulation & additional membrane sheeting over the top of the insulation.

Inverted Roof systems (Protected membranes) are typically installed on concrete plaza decks, structural concrete, or other metal decks on rooftops. The membrane is adhered directly onto the concrete deck with the insulation and overburden on the ‘wet side of the roof’.

BUILDINGINTELLI^{TM}: ROOF MONITORING

The application of a moisture detection system to a conventional roof differs from an inverted roof due to the nature of the installation and the electrical methodology of each. The basic methods are similar for cabling, installing detection sensors, and terminations of each.


Building Analytics
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Mositure Detection Sensor (MDS) Tape
Exact location, layer of roof of MDS
installation and grid size are dependent
on the roof installation
Conventional Roof
Membrane
Protection
Board
Insulation
Vapour Barrier

Figure 1: The comparison of the Moisture Detection Sensor Tape installation location in Inverted Roof and Conventional Roofing Systems

SMT's BuildingIntelli^{TM} membrane monitoring system is a comprehensive, continuous, permanent, electronic integrity monitoring solution for the roof membrane and insulation system. A permanently installed grid provides the ability to source a location where a fault can be detected. Sensor density and spacing can be varied to achieve the desired granularity or resolution of moisture detection as well as conforming to budgetary constraints.

CONVENTIONAL LOW-SLOPE ROOF SYSTEM

A system of linear Moisture Detection Sensors (MDS) is installed in a grid below the membrane either under the protection board on below the insulation in a conventional roof system shows when moisture accumulation has occurred.

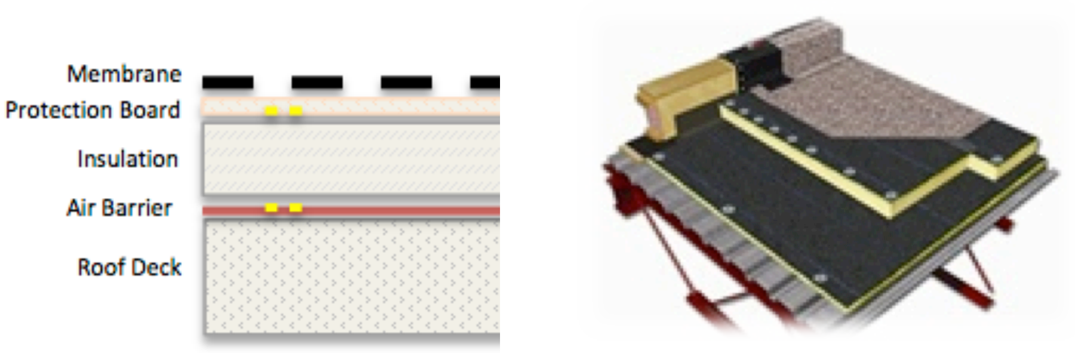


Figure 2: Conventional Low-slope roof location of MDS Sensor Tape shown at under protection board OR at the lowest point in the assembly on top of the air barrier.

Electronics are configured to continuously monitor the characteristics of these sensors. In a Conventional roofing application when water contacts the detection tape, these characteristics change in a predictable manner.

The theory behind the architecture of linear moisture detection sensors (MDS) when used in sensing from dry to a wet condition is relatively straightforward. Two or more conductors are exposed to the environment as sensing elements and an electrical characteristic is measured, most often resistance between the conductors.

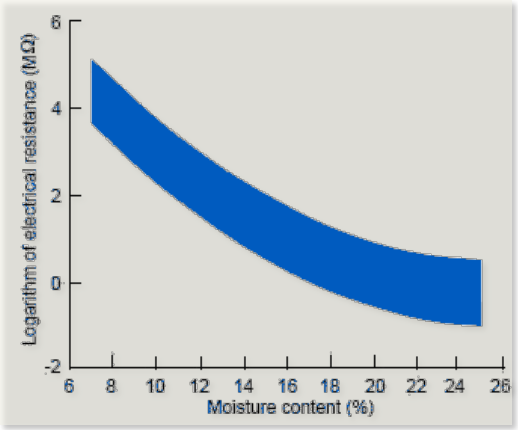


Figure 3: Electrical Resistance related common Wood Moisture Content

The units of measurement for our Moisture Detection Sensor Tape (MDS) is in kilo-ohms, which is a electronic measurement of the resistance on the detection tape. In order to correlate this measurement to wetness of material under the roof membrane we use the following conversions:

Measurement	Tape Status
Under 0.1k	Shorted or Extremely Wet Detection Tape
5k to 50k	Wet
50k to 400k ohms	Moderately Damp
1,000k to 10,000k	Dry

A Wet Detection Tape when measures below the wet threshold values and the SMT graphical overlay shows the entire length of the detection tape to shown in RED when the numerical values show a wet detection tape. This can be misleading to the reader when only a very small portion of the detection tape may only have small amount of water bridging just one inch or 1 millimeter of the detection tape. The ability to locate the precise location of moisture along this detection tape length is difficult

Note that the MDS tape is NOT a lab calibrated sensor, the sensor does not detect for certain how much water is present based on the reading. However, we can detect the presence of moisture and record relative readings and observe trends.

Moisture on MDS tape is different than moisture content on a wall assembly or water leak detection in flood monitoring applications.

MDS tapes vary in lengths, conductive material along tape act as a parallel resistance. Resistances along tape accumulate according to the parallel resistance formula.

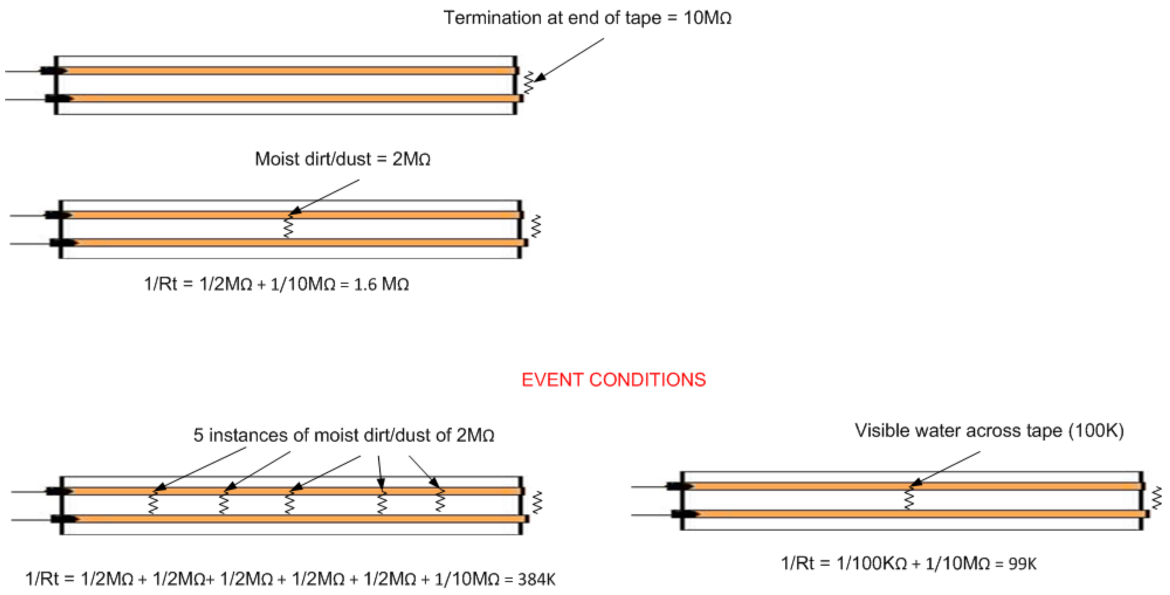

Termination at end of tape = 10MΩ
Moist dirt/dust = 2MΩ
1/Rt = 1/2MΩ + 1/10MΩ = 1.6 MΩ
EVENT CONDITIONS
5 instances of moist dirt/dust of 2MΩ
1/Rt = 1/2MΩ + 1/2MΩ+ 1/2MΩ + 1/2MΩ + 1/2MΩ + 1/10MΩ = 384K
Visible water across tape (100K)
1/Rt = 1/100KΩ + 1/10MΩ = 99K

Figure 4: Conventional Roof Monitoring Event Conditions

The Building*Intelli*^{TM} monitoring system then reports the following states:

- Sensor intact and monitored (normal state)
- Sensor faulted (damaged or shorted by method other than water)
- Water present (moisture detected)

LINEAR MOISTURE DETECTION SENSORS

A Wet Detection Tape when measures below the wet threshold values and the SMT graphical overlay shows the entire length of the detection tape to shown in RED when the numerical values show a wet detection tape. This can be misleading to the reader when only a very small portion of the detection tape may only have small amount of water bridging just one inch or 1 millimeter of the detection tape. The ability to locate the precise location of moisture along this detection tape length is difficult.

We recommend that time be given to monitor and allow the inherit construction moisture to settle in, prior to drawing conclusions. Over time the condensed moisture on our detection tape may migrate and clear it self - especially in cases where a very small amount of water has bridged our detection tape and the summer sun heats the roof membrane to 70C and changes the water to water vapour which is then absorbed into the various construction materials

Due to tape's low profile and self-adhesive characteristic, it is rapidly become the sensor of choice in monitoring applications in under roof membranes and in the case of inverted room membranes, the topside.

SMT engineers proprietary moisture and leak detection sensors suitable for applications in new and existing buildings provide solutions tailored to the application and environment: sensors are available for flood detection, roof monitoring, building envelope monitoring, and critical asset protection.

Linear Moisture Detection Sensors are designed to survive the trauma of the construction environment. Careful attention has been paid to the robustness and longevity of the sensor. The system can be installed in open and unprotected locations where light foot traffic and wheeled carts traverse the sensor.

Adhesives employed are of the highest quality and have been selected to adhere to common construction material such as concrete, metal, gypsum, plywood and other materials. They are designed to maintain adhesion below -20C while also withstanding direct sunlight and temperatures in excess of 60C.

SMT's Linear Moisture Detection Sensors have the following benefits over other sensors available on the market:

- Sensor design provides **rapid response and recovery** to moisture events.
- The system is **contamination resistant and easily maintained**. Competing systems rely on easily contaminated protective layers to safeguard the sensing element. SMT's solution provides robust, durable sensors that readily withstand contamination and cleaning:
    - No build-up of conducting metal oxides resulting in false readings.
    - Easily cleaned and maintained. Dust (in particular hygroscopic particles such as gypsum) and metal filings from construction/operations will not contaminate the sensor.
- **Low profile, self-adhering, non-intrusive** design reduces tripping hazard and allows for foot and cart traffic. Alternative sensor systems use a rope or coil of material to sense water over a distance that can be cumbersome once installed and cannot be exposed to traffic.
- Self adhesive peel and stick Mylar substrate is ideal for any and all applications to metal surfaces that remains an **easy to install** and cheap to maintain solution. Tape forms easily to contours and is applied readily in troughs, over and around conduit, pipes, and other services installed in the building.
- Manufactured from **quality materials** from suppliers such as 3M and DuPont using proven processes and techniques.
- **Straightforward repairs** to damaged sensors. User installable splice kits facilitate rapid resolution of accidental damage.
- Positive termination indication on all linear sensors provides **immediate and precise fault detection**.

STAINLESS STEEL MOISTURE DETECTION SENSORS

Typically, rolled copper is used as the conducting element in tape style sensors; however, when copper is exposed to high relative humidity or condensation/moisture for any length of time, in particular when subjected to an electrical potential, it rapidly oxidizes. This leads to corrosion and unreliable measurement. Over extended periods of time, the conductors can fully corrode in moist environments, rendering the sensor useless. This is particularly a problem if the location is not accessible for replacement.

SMT has developed a unique solution to the problem of sensing moisture in high relative humidity and condensing environments (such as roof systems): **linear stainless steel detection tape**. Stainless steel does not suffer from the effects of oxidation in the same way copper does.

STAINLESS STEEL MOISTURE DETECTION TAPE (MDS-SS) CHARACTERISTICS

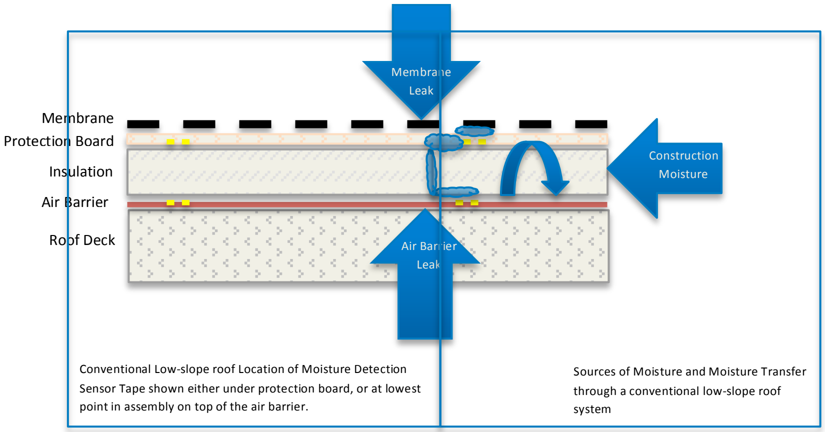
- Type 316 stainless steel conductors – corrosion resistant yet flexible enough to conform to all contours.
- 30+ year lifespan in roofing applications.
- 3M Mylar backing layer – robust substrate insulates sensors from underlying structure.
- Heat resistant.
- 3M high strength adhesive with release liner – allows for rapid sensor deployment across a wide range of temperatures and materials.

Compared to copper (Cu) based sensors, stainless steel (SS) sensors will NOT:

- Develop conductive oxides when subjected to high relative humidity or condensing environments.
- Provide false positives due to corrosion bridging conductors.
- Enter into unwanted galvanic reactions with common building materials.
- Become friable due to significant loss of material through reduction/oxidation.

MOISTURE IN A CONVENTIONAL ROOF SYSTEM

See the cross section of the conventional roof below. In selection of the location of the moisture detection sensors, it is important to understand the moisture intrusion locations associated with these type of assemblies. The water can accumulate in various layers of the roof, including the protection board, under the roof insulation, and even under the air/vapor barrier located on the roof deck.

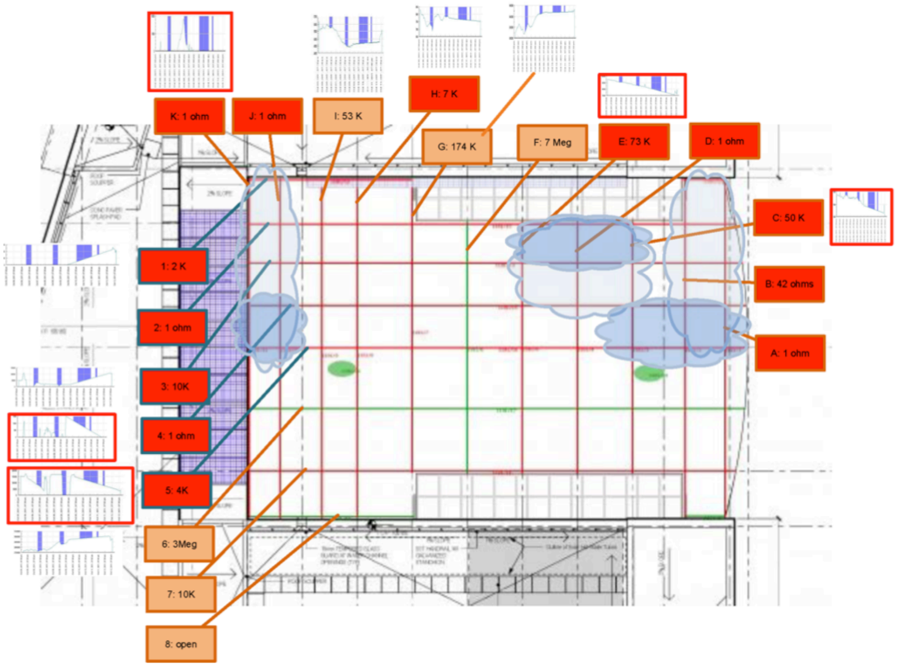


Conventional Low-slope roof Location of Moisture Detection Sensor Tape shown either under protection board, or at lowest point in assembly on top of the air barrier.

Sources of Moisture and Moisture Transfer through a conventional low-slope roof system

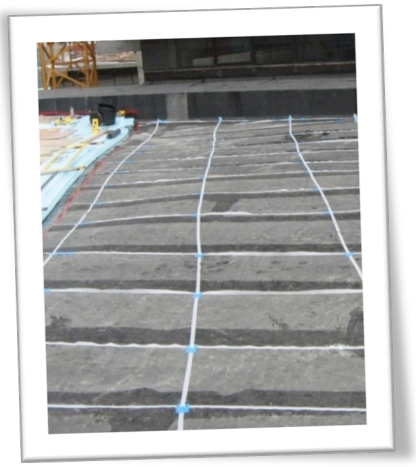
The moisture accumulation in areas with-in the conventional roof assembly can come from the moisture trapped with-in the assembly at the time of construction, from a membrane breach and bulk water intrusion, or from an air barrier leak where the interior warm moist air condenses with in the assembly.

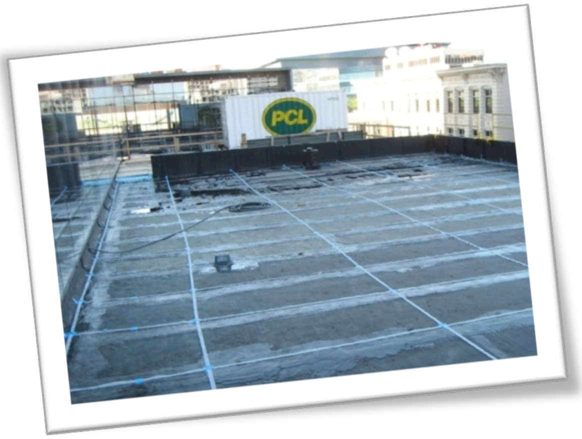
The placement of the sensors in a grid in the conventional roof enables the locating the moisture in the assembly by having the sensor locations indicate the vertical and horizontal grid axis as to the location of the moisture accumulation.



In order to enable full time monitoring, evaluation, and reporting of membrane and/or roof performance, the sensor data is co-ordinated through advanced hybrid (wired and wireless) monitoring nodes, an electronic gateway, and Building Analytics datacenter. Together, these components form the SMT *Building Intelligence* Platform.

In conventional low-slope roof systems SMT recommends that a monitoring system be installed immediately after the installation of the sensors to enable automated reports to be issued on the status of the roof construction moisture, and water testing from recent rain events. The monitoring of roof Moisture Detection Sensor Tape Grid Systems over time, can give trends as to the drying or wetting of the related roof assembly components. A moisture detection tape in which shows a quick change to low resistance is most probable as a bulk water leak from a membrane breach. In conjunction with site data and nearby weather station data one can correlate the event to the most probable cause.



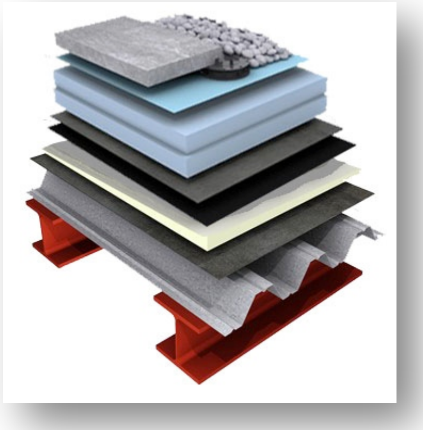


Stainless Steel water detection sensors are installed in layers on an inverted roof prior to further installation of the green roof system.

Linear Moisture Detection Sensors and cabling are coordinated and installed on membranes of inverted roof systems.

INVERTED ROOF SYSTEM

A system of linear Moisture Detection Sensors (MDS) is installed directly to the top of the water proof membrane in an inverted roof system. The inverted system monitors for breaches in the membrane, as opposed to moisture accumulation monitoring in Conventional roof systems.

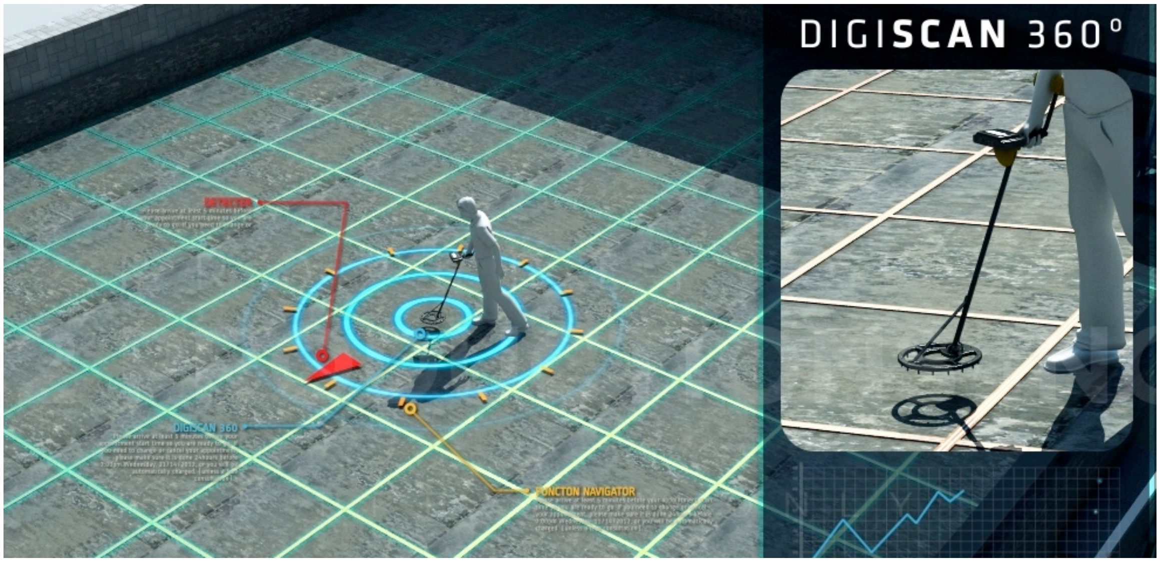


The inverted system works with membranes that non-conductive such as 2 ply SBS, hot melt and modified bitumen mop on systems. The roof deck must also be conductive to electricity – such as a concrete deck and metal deck systems. The inverted roof monitoring system is best understood when the SMT DigiSCAN 360 service is understood first.

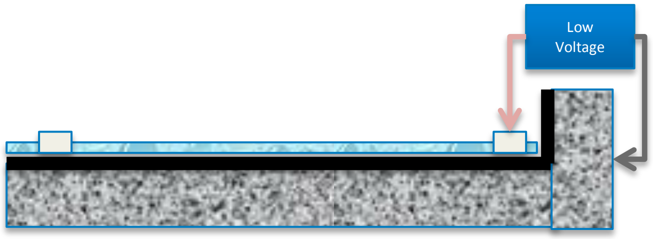
DIGISCAN^{TM} 360° SERVICES: MEMBRANE SCANNING

The roof scanning method of DigiSCAN^{TM} Digital Multi-Vector Mapping (DMVM) Scan shall be applied to test the integrity of the inverted roof or water proofing membrane. This service is similar to the concepts used in Electric Field Vector Mapping, with a key difference in the usability of the equipment and the time in which it requires to find faults in the membrane. Faults in the membrane shall be located and marked for repair by the roofing contractor. Repairs shall be retested for effectiveness. All penetrations and other details creating a path to the buildings electrical ground shall be guarded. Various types of roof membranes may be scanned, including inverted roof membranes of torch down, hot applied liquid, and/or loose laid systems.

The DigiScan system can be used in conjunction with SMT Stainless Steel Moisture Detection Tape (MDS) permanently installed on the top or wet side of the inverted roof membrane or water proofing system. The SMT MDS is installed in 2m x 2m to 3m x 3m grid layouts and with grounds around the drains – with wires from each grid terminating back to terminal box. The DIgiScan Tx Power Supply is then grounded to the concrete deck below the membrane with the positive side of the DigiScan Tx Power Supply connected to the Grid Area of the Roof under scan. A light layer of water sprayed on the membrane, bridging the stainless steel conductors of the grid area. Once the DigiScan Tx Power supply and film of water is place the DigiSCAN^{TM} can be commenced.

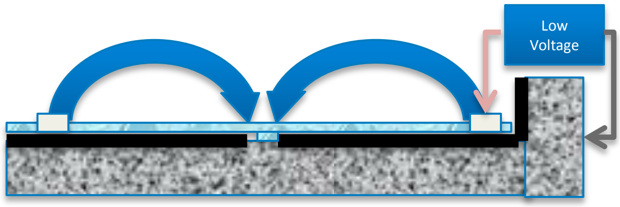


The diagram below shows a cross section of the concrete deck (grey) and the membrane (black) directly adhered to the top. When intact and without a leak, most waterproofing membranes are an electrical insulators and no electricity shall pass between the charged grid system (white) and the roof deck below. The screen on the DigiSCAN shows that there is only a small mV of potential on the water film between the grids. The direction of the potential vector will also change location rapidly and randomly.



4.601mV
GAIN:LO

Once a membrane breach occurs the electrical potential induced by the DigiScan Tx low voltage power source travels down through the breach to the concrete deck below. The DigiScan Screen shows the magnitude and also the direction of the vector pointing to the location of the leak. Once the DigiScan unit is moved over and past the hole, the locating arrow and vector shall change directions to indicate the location of the whole. The magnitude will go low when immediately over the breach. The leak may be invisible to the naked eye, and in some cases maybe a small imperfection in the concrete deck piercing through the membrane.



2.779 V
GAIN:LO

See the SMT DigiSCAN Advanced User Manual for more details on the set-up and user details of the system.

1.812 V
GAIN:LO

The DigiSCAN™ Roof Scanning can be completed at various phases of the project:

- **Phase 1: Scan immediately after the membrane has been installed.** This confirms that the waterproofing contractor has caught all the possible imperfections and non-visual penetrations have been located and repaired.

- **Phase 2: Scan while roof membrane is exposed.** Depending on the construction schedule, the roof membrane may be "open" or used as a temporary staging area. Between the time when the membrane has been installed and the time the roof is protected with landscaping, there is high risk of damage to the membrane. A roof scan can be completed just prior to installation of the protection of the overburden, landscaping or green roof media.

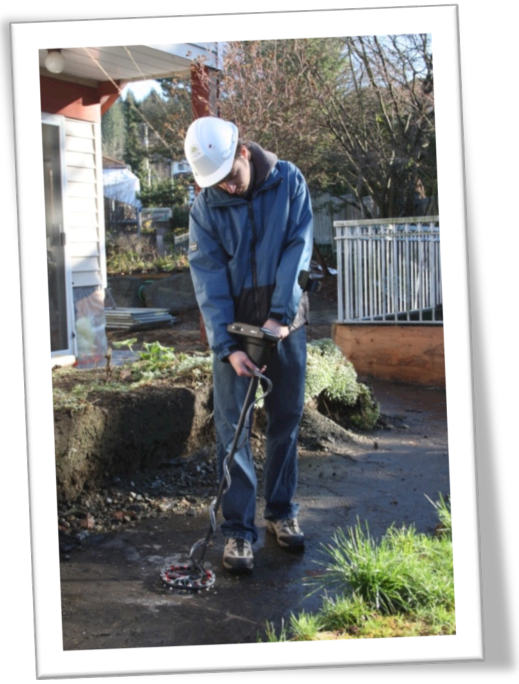
DIGISCAN™ 360° SERVICES: SCANNING WITH PERMANENT INSTALLED GRID

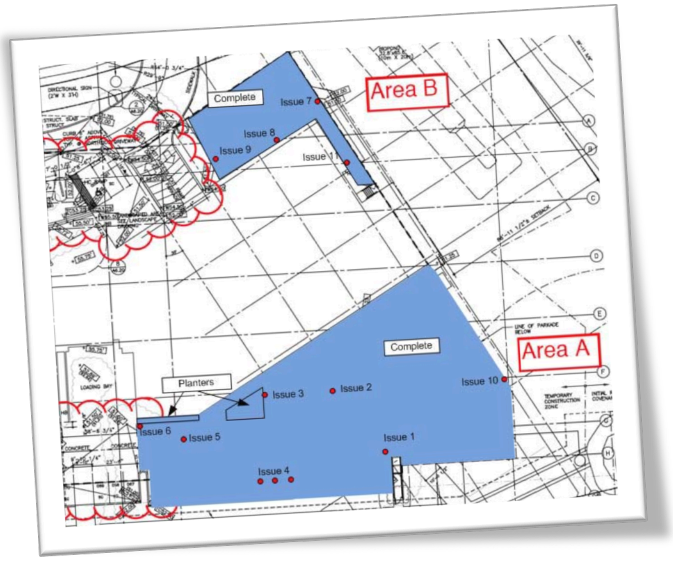
The DigiSCAN™ roof scanning method shall be applied to test the integrity of the membrane as is, but with the addition of an electrically conductive grid permanently installed over the protected membrane so that subsequent scans can be performed over the life span of the roof while the over burden and landscaping is in place.

Prior to the installation of the root barrier, drainage planes, and other overburden, faults in the membrane shall be located and marked for repair by the roofing contractor. Repairs shall then be retested for effectiveness. The conductive grid for future testing is left in place on top of the roof membrane.

DigiSCAN™ locates a membrane penetration along the edge of a planter system.

DigiSCAN™ detecting a localized membrane breach. The arrow points to the direction of the leak.




Area B
Complete
Issue 7
Issue 8
Issue 9
Issue 11
Area A
Complete
Planters
Issue 3
Issue 2
Issue 10
Issue 6
Issue 5
Issue 1
Issue 4

DigiSCAN^{TM} locates membrane penetration on existing roof membranes.

DigiSCAN^{TM} 360° Service including digital records, photos and reports from SMT

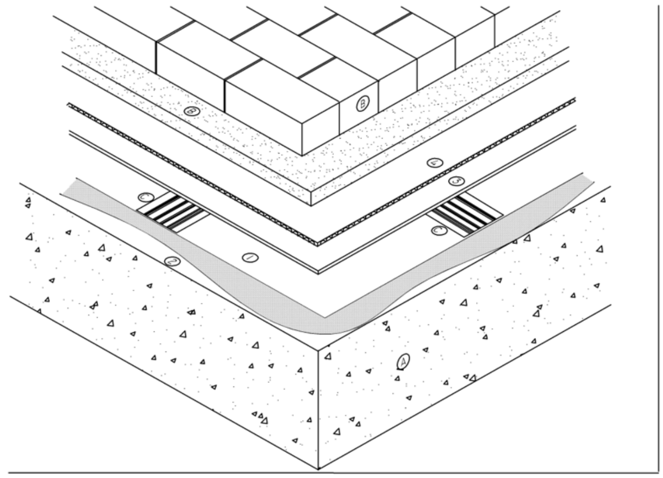
ROOFING CONTRACTORS ASSOCIATION OF BRITISH COLUMBIA, GUARANTEE CORPORATION REQUIREMENTS FOR WATERPROOFING APPLICATIONS.

The Roofing Contractors Association of British Columbia (RCABC) has implemented a Roofing Guarantee Program that provides building owners an assurance that quality materials will be installed to specific standards by professional roofing contactors.

As part of the RGC Guarantee Program a membrane moisture scan survey & report which confirms the water tight integrity of waterproofing system is a mandatory requirement for all RGC Waterproofing Guarantees with-in certain types of roofing and waterproofing systems.

A series of moisture monitoring sensor grids are mandatory and shall be installed on the top surface of all waterproofing membrane systems designed with inaccessible overburdens and wearing courses. The intent of the moisture monitoring sensors as deployed is to confirm membrane integrity without removing the inaccessible overburden or causing any undue site damages.

The location of the moisture integrity sensor grids is shown on the diagram below.



Legend:

(1) Primary Waterproofing Membrane: Fully adhered to acceptable substrates (concrete slab shown)
(2) Membrane Primer or Adhesive: Proprietary primer or adhesive.
(3) Protection Board/Mat: Proprietary membrane protection board
(4) Drainage Medium: Proprietary (purpose-made) geocomposite drainage boards with synthetic water permeable fabric required to contain sand and gravel beds for unit masonry (pavers, bricks, and stone).
(A) Acceptable Deck: Concrete slab depicted.
(B) Wearing Course: Concrete slab (depicted) or pavers, bricks or stone set in mortar beds

(D) Conductive Tape: Moisture Survey System (tape grid) mandatory and compliant with RGC Guarantee

Figure 5: Moisture Monitoring System Tape Grid (Credit: RGC Roofing Practices Manual)

The three-part specification for the RGC Roofing Guarantee Program is included in the Appendix. The following diagrams outline that a Moisture Detection Grid be placed on the topside of an inverted waterproofing membrane with 3m x 3m (10 ft. x 10 ft) spacing when the overburden or warring layers are of 8” and below in construction.

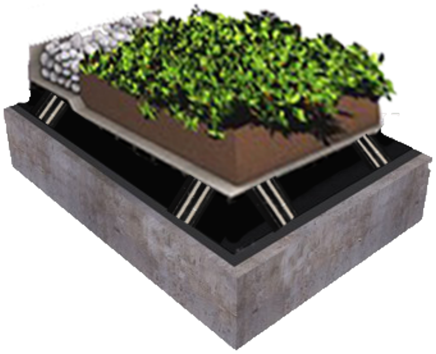


Figure 6: Typical extensive green roofs of depth under 8 inch require a 3m x 3m grid to obtain the RCABC Warranty

Typically if you can use a shovel and knife to get to inspect the membrane a 3m x 3m grid spacing is approved. If you need to use a jackhammer to inspect the membrane a 2m x 2m grid spacing is required.

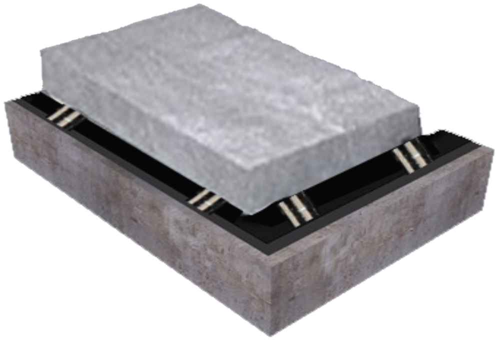


Figure 7: Permanent overburden of concrete or similar require a 2m x 2m grid to obtain the RCABC Warranty

The sensor and cables are required as part of the Guarantee program so that at a later date electronics or a DigiSCAN manual scan can discern where a leak in the membrane may be located to reduce the overall cost of the repairs to roof leak.

Typically the electronics are not included in the base bid and the electronic monitoring system is only utilized with periodic maintenance scans or during a time when a membrane breach is evident and location needs to be discerned quickly and cost effectively.

LAYOUT AND ESTIMATIONS OF CABLE SYSTEMS IN A GENERAL ROOFING LAY-UP. *UNDERSTANDING CABLE ROUTING & SENSOR PLACEMENT.*

The layout of the moisture detection sensor grid and cabling systems are to be coordinated with the architect, specifying engineer, general contractor, roofing contractor, and SMT technician. Various options exist to define the layout of the detection grids and map the exact sensor placement as to enable various budget options to counter particular threats from a membrane breach. The system designer should understand the asset being protected and the type of construction of the roof so that risk factors and subsequent appropriate grid spacing can be applied.

Example of Moisture Detection Tape Layout:

A typical low-slope conventional roof can be laid out and achieved within various budgets and various degrees of monitoring resolution. The Moisture Detection Sensor Layouts below outline an a-typical 10 ft. x 10 ft. grid, perimeter only monitoring and then perimeter with the addition of penetration monitoring.

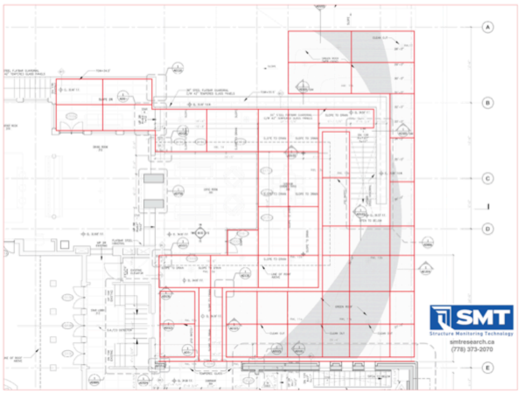


Figure 8: Moisture Detection Roof Grid with approximately 10 ft. x 10 ft. grids.

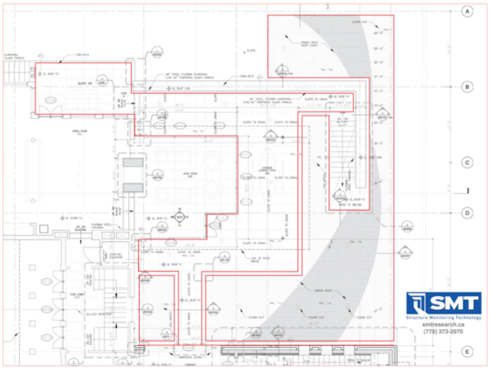
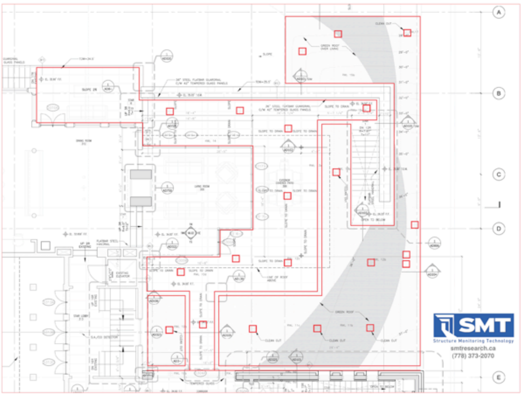
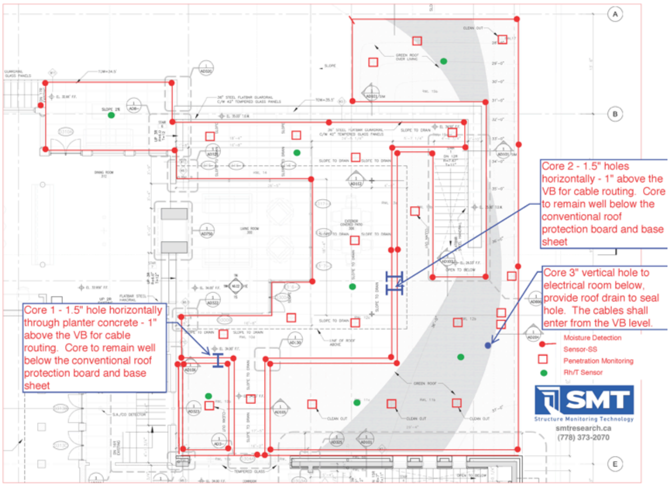


Figure 9: Moisture Detection System on Perimeters Only.




Core 2 - 1.5" holes horizontally - 1" above the VB for cable routing. Core to remain well below the conventional roof protection board and base sheet

Core 3" vertical hole to electrical room below, provide roof drain to seal hole. The cables shall enter from the VB level.

Core 1 - 1.5" hole horizontally through planter concrete - 1" above the VB for cable routing. Core to remain well below the conventional roof protection board and base sheet

Figure 10: Moisture Detection System on Perimeters with Drain Monitoring

Figure 11: Conventional Roof Monitoring with Perimeter and Penetration Monitoring. Red Circles show the locations where Moisture Detection Sensors (MDS) terminate to cable.

The Moisture Detection Sensor (MDS) is terminated to electrical cable: 2 pair 22 gauge stranded cable. The routing of cable is done through informal pathways created on the roof deck. Coordinate the installation of the cables with the roofing contractor to attempt to keep the bundle of sensor cables on the “high” side of the drainage planes.

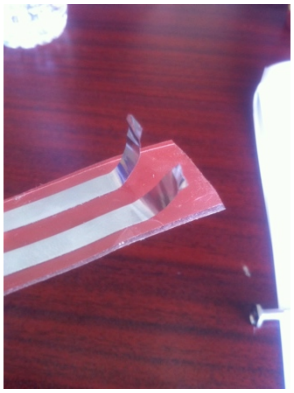
Conventional Roof Note: The Moisture Detection Sensor (MDS) and cabling is located in a “dry” building element – under the roofing membrane. The cable routing options in these cavity types are generally open. The cables can be bundled as soft jacketed cabling to the approved cable exit in the area where electronics will be installed for monitoring. It is important to coordinate the routing with the construction team and roofing contractor, as wall scheduling any scanning and/or coring that may be required for passing cable through planter walls, slabs, or menzies as to best reach mechanical rooms, crawl spaces, and/or roof membranes. See installation details for photos of various methods. The attachment of cables to the structure in question are best completed through the vapor barrier using approved methods.

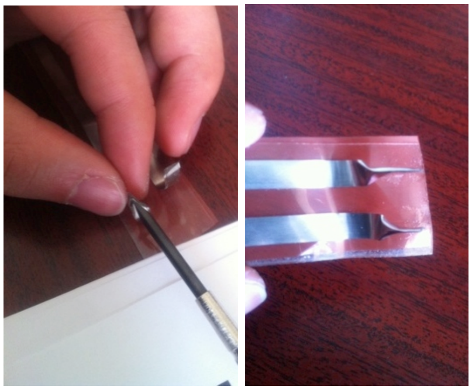
Inverted Roof Note: The Moisture Detection Sensor (MDS) and cabling is located on the “wet” side of the membrane. The cable routing should attempt not to penetrate the membrane below. Consult with the construction team and roofing contractor on details of proposed cable routing. Typically the cable is tie wrapped together and collected to one point of termination on each roof deck per RCABC recommendations and applicable industry standards.

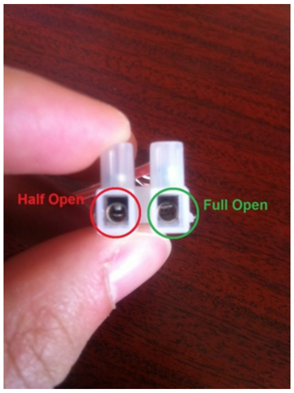
DETAILS OF MOISTURE DETECTION SYSTEM CONSTRUCTION, ROOF DRAINS, CORNERS, AND EDGES.

There are differences between the termination and final layouts of conventional and inverted roof membranes. The following termination methods are applicable to Conventional and Inverted Roof Membranes. Targeted monitoring areas need to be clean and the membrane should preferably be blow torched and cleaned again to strengthen the sensor adhesion. Membranes must be clean, dry, and above 5 degrees centigrade during installation for best results.

Stainless Steel Moisture Detection Sensor (MDS) Termination



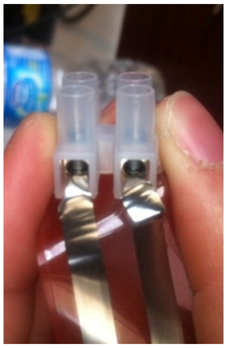


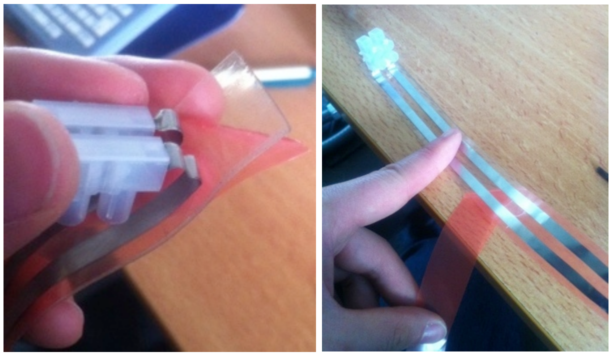


2.1 – Pull MDS-100-SS off roll and peel stainless steel leads back.

2.2 – Push steel leads with any flat tool in half. Ensure that the leads are small enough to fit into MDS-TERM.

2.4 – NOTE: fully open MDS-TERM as the folded stainless steel leads barely fit.

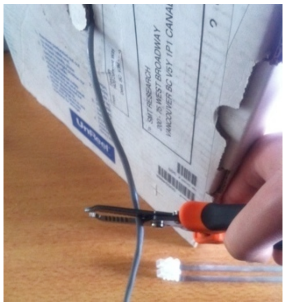




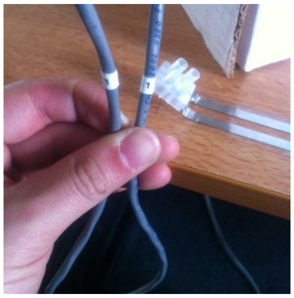
2.5 – Place folded leads into MDS-TERM and tighten screws.

2.6 – Expose adhesive and lay down MDS along targeted location. Check for good MDS adhesion to membrane by applying pressure along MDS tapeline from end to end.

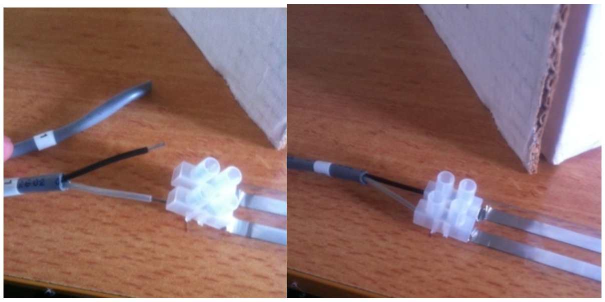
Termination Methods to Cable



2.10 – Place 22 AWG wire next MDS-TERM block and run wire to junction box – WiDAQ – or central point of termination and cut wire.



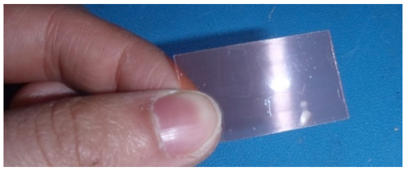
2.11 – Label cable with wire ID number on both ends.



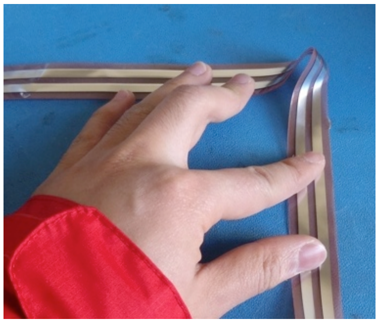
2.12 – Strip one side of wires and connect to MDS-TERM and tighten.

Note on Cabling Type: Any 2 conductor cabling will do the job, as the moisture measurements are basic DC resistance. SMT technicians have found that the best and most reliable cable is a Twisted 22 AWG Stranded 2 conductor cable. The stranded 22 AWG gives a good quantity of wire strand/material when individually stripping and screwing down each terminal block screw. If the installers work with a 24 AWG Solid Conductor (Cat3/5e/6 cable) there is a limited number of times that the termination can be moved prior to the single conductor breaking. The twists on the 22 AWG gives good noise and interference cancellation as opposed to the 2-conductor station wire.

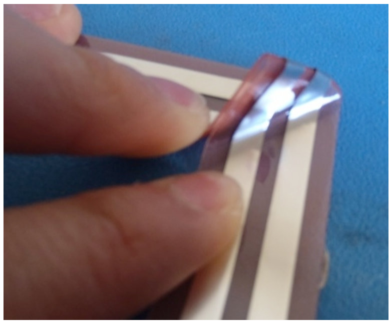
1. Corner Folds and Roof Drain Monitoring



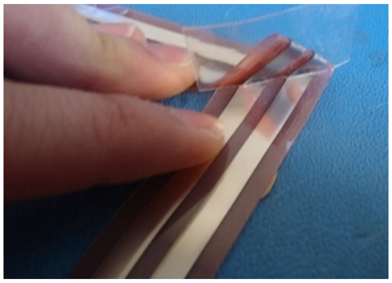
4.1 - Cut three 1” MDS and remove conductive lines. These will be used to prevent shorts when folds at corners occur. Repeat this process and cut three 2” MDS as well.



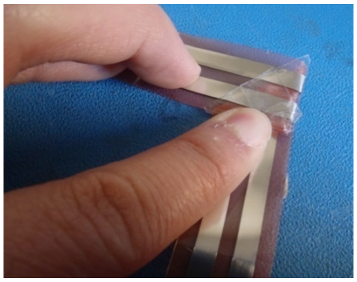
4.2 – Take MDS tape and fold a 90-degree angle.



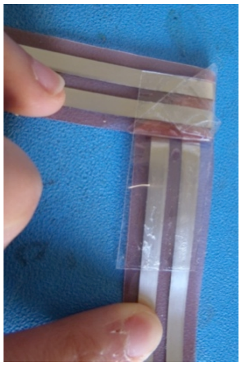
4.3 – Crease the fold.



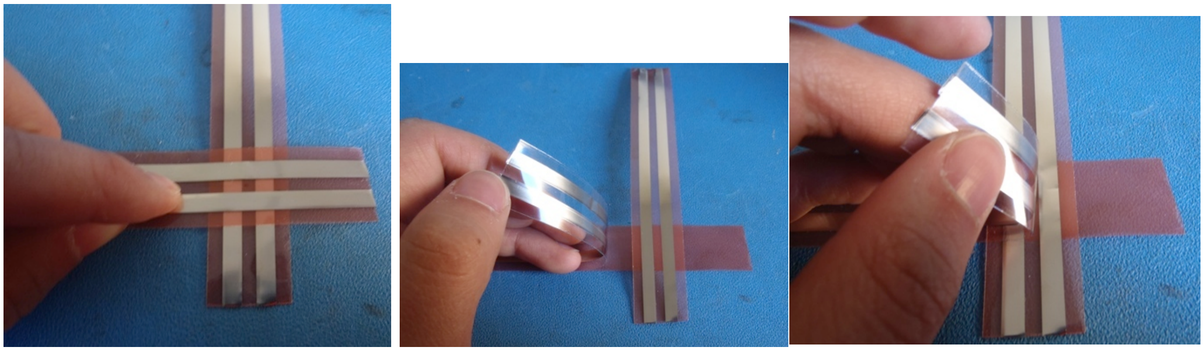
4.4 – Place one 1” MDS without conductor horizontally across the fold, placing bottom of tape flush to the crease.



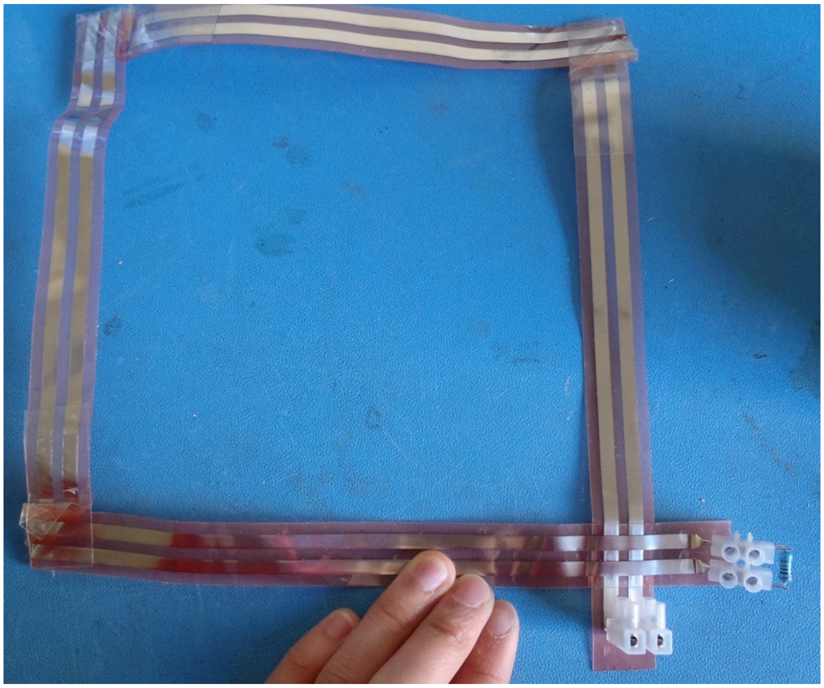
4.5 – Fold non-conductive tape and surround the folded triangular edge of MDS tape.



4.6 – Place 2” across the folded region so no folded edges remain upright.



4.7 – Repeat this process 3 times to form a square. At the fourth/final corner, place the incoming MDS tape in between the MDS adhesive side and its plastic backing. For this application and as applicable with dependent Mylar backing, ensure there is never a tape conductor directly contacting another conductor, as this will fault the sensor. The objective is a continuous and un-faulted loop.

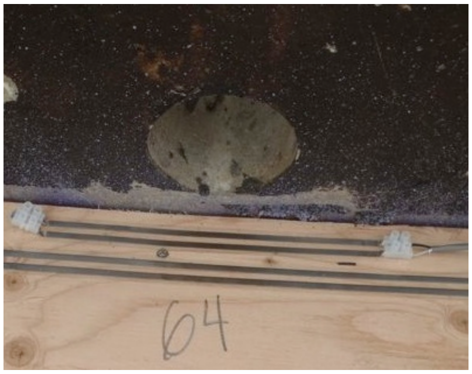
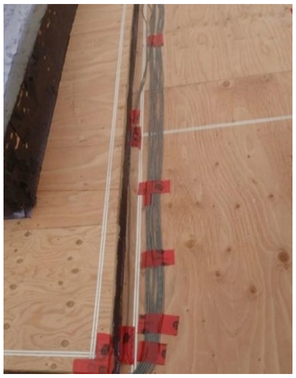
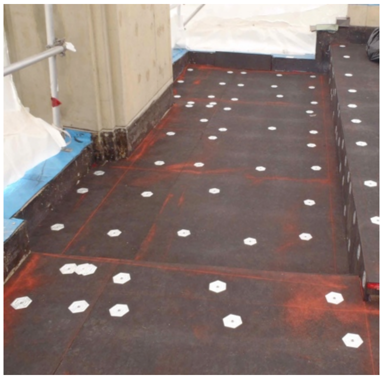
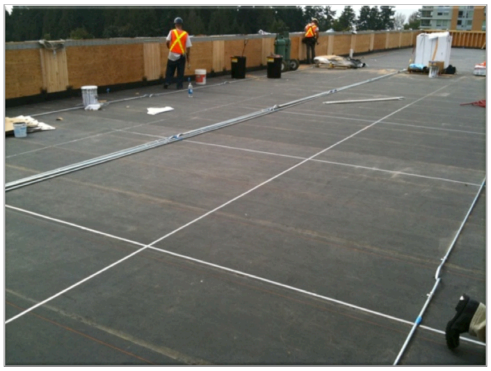
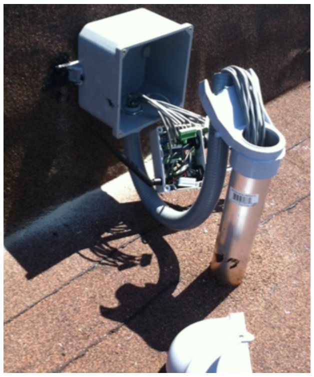
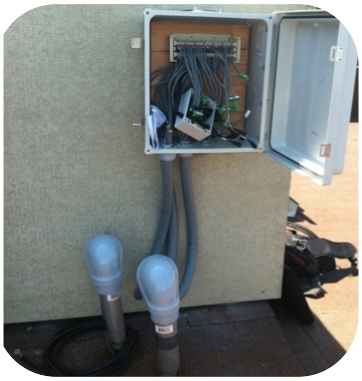


4.8 – Place connectors at the ends, one with and one without a 10M Ω resistor.   Note: Only the conventional roof

Installation Examples and Specific Details Related to Conventional & Inverted Roof Systems

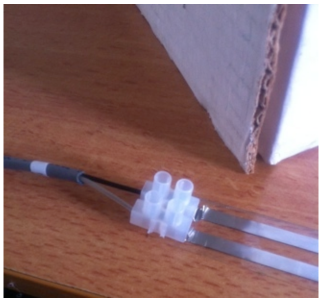
Conventional Roof Monitoring System

The Conventional roof moisture detection sensor can be installed in various layers on the roofing system – including adhered to the roofing deck under the vapor barrier, above the vapor barrier, above the insulation or immediately under various layers of protection board/traffic cap. Consult with the architect / engineer and SMT technician as to the exact location of the MDS. The MDS-SS most commonly is installed on the vapor barrier so that any roof leaks from above will tickle to the lowest point in the roof system and travel to an MDS prior to penetrating the vapor barrier. Temperature sensors are also installed in the Conventional roof to identify times in which condensation may be a contributing factor to the build-up of moisture in the roof insulation and on the vapor barrier.

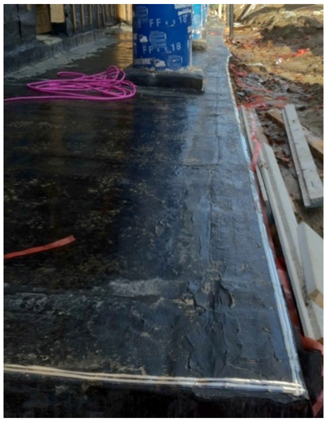
		
MDS-SS installed on wood deck by roofing detail of a scupper. Note the installation of a 10 Megaohm termination resistor. Cable ID also labeled on deck for photo documentation.	MDS-SS on in Grid with cables bundled and adhered to wood deck.	Projection board installed over top of MDS-SS. Note the coordination with chalk lines indicating where not to use mechanical fasters.
		
MDS-SS shown in 10 ft. x 10 ft. grid installed on vapor barrier of conventional roof. Note the conduit with electrical protection from shorting the MDS.	Cables on a Conventional roof transitioning through roof membranes and a menzies before going into a termination box (8 cables).	Cables on a Conventional roof transitioning through roof membranes and menzies before terminating in an approved enclosure (50 cables).

Inverted Roof Monitoring System

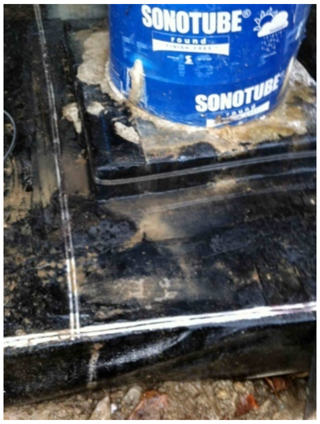
The Moisture Detection Sensor (MDS) and cabling is located on the "wet" side of the membrane in an Inverted roofing system. The cable routing should attempt to not penetrate the membrane below. Consult with the construction team and roofing contractor on details of cable rounding. Typically the cable is bundled together and collected to one point of termination on each roof deck.



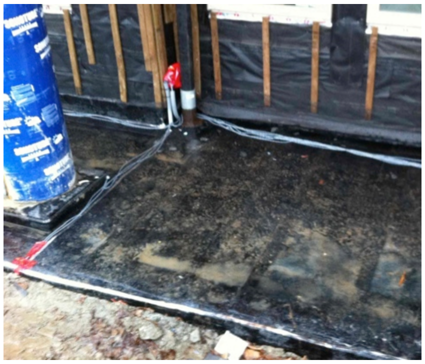
The terminations and cable order for the MDS must have consistency in polarity at all times. SMT uses the following conventions:
On the North-South MDS - Black Wire on West
On the East-West MDS - Black Wire on North



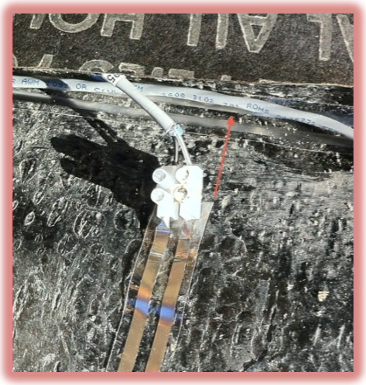
MDS-SS shown on the edge of plaza deck waterproofing. Note the overlap of conductors on the corners; each line segment is fully overlapping each other.



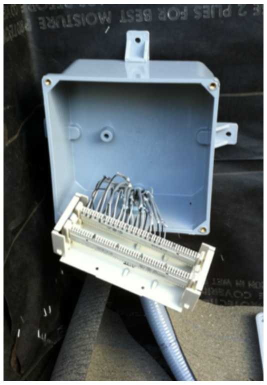
MDS-SS installed on the edge of a deck, and termination to cable on "high" side of deck. Also notice the "ring" around the column to guard out the grounding effects of the reinforced column.



Cables are bundled loosely and laid on top of the waterproofing membrane. The cables terminate through flexible conduit to an approved junction box.



Terminations on the inverted roof must overlap the nearest grid to create an even electric field on top of the membrane.



Termination of MDS cables on BIX in a weatherproof enclosure.

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Documentation

- Photographs are required and MANDATORY for each MDS Tape sensor installed.
- Whole zones need to be photographed showing the MDS in relation to any identifiable building elements; windows, doors, roof penetrations, etc.…
- More importantly, photographs are necessary to document with accuracy and for commercial liability protection the to show conclusive conditional evidence as to sensor installation installed, observed leaks or penetrations, or for any other purpose associated with the proficiency and accuracy of this industry profession.
  - During installation, circumstances will arise where custom angles, bridges, or pass-through must be utilized to complete the grid or path for the MDS.
    - Such occurs when aftermarket or secondary construction has put an obstacle in your path that may not be reflected on any drawings.
    - In these instances having flexibility is mandatory to achieve the desired outcome.
    - Documenting each phase of zone deployment, as it was before installation, as it is installed, and as it becomes, following roofing completion is vital.
    - Knowing to the inch or millimeter where the sensors are is invaluable for trouble shooting, maintenance, or for sensor safety, when for instance metal fasteners or other mounting hardware are to be installed in the area.
    - Site damage remains the largest obstacle to complex deployments over protracted periods of time.
      - Area notices, Site CSO briefings, and general caution and awareness campaigns about the products deployed should be utilized to reduce damages, lost labor hours, and/or financial decay.

Log all data and information of where tape is for as-built drawings and documentation

- As-Built Drawings need to have CABLE ID labels, as well any location changes made to the drawing. The SMT monitoring system identifies the location of moisture in relation to the sensors. This information is with more developed site projects, uploaded and managed from the online Analytics database. Having detailed imagery and notes on each site allows for more complete remote site management services.

- Material to be covered in later sections will highlight the tactical importance of the 3 industry pillars involved in professional moisture monitoring implementations.

  - ***Deployment*** (Service, Scope, Design, Source, Schedule, Install, Clean up)

  - ***Certification*** (Configure, Program, Test/Solve, Verify, Guarantee & Authorize)

  - ***Monitoring & Analytical Reporting*** (Communication, Configuration, Monitoring, Analyzing, Reporting, Adapting to changing needs and environments)

CONSTRUCTION SCHEDULING AND COORDINATION WITH ROOFING AND OTHER SUB TRADES.

The success of the installation as pertains to customer satisfaction and profitability starts with clear lines of communication and good coordination. Roof and waterproofing installations often are coordinated in quick on-site mobilizations during times of sunny dry weather or fierce precipitation and moisture.

Preinstall preparation:

- Inventory of MDS-SS
- Termination Blocks
- Termination Resistors (Conventional Roof Only)
- 2C-22AWG Stranded Cable
- Cable Labels
- Roofing and Waterproofing Plans
- Digital Camera
- Basic wire / cable tools

The installation can be coordinated best by issuing a clear outline of the tasks at hand to all involved parties. Providing this to the roofing company, as to show the locations and routing of cabling and MDS, is very important. The installation of the latter is often the first installation of any low voltage system on a new construction site. It is likewise most susceptible to site damage.

Specific situations will arise where the installer must act in unison with the roofers and other contractor trades to deploy in a finite window of opportunity. An installer is also a safety observer. Great care and attention to detail must be given when working under these parameters. Situations of bad weather and delayed site work sees rushed and hastily performed “progress”. Watching and educating the other trades who you must work with as a team to the sensitivity of these elements as they are foreign to most, will greatly reduce commercial liability and material loss, as electronics, no matter how durable and tough, can easily be damaged by carelessness.

SMT BUILDING INTELLIGENCE PLATFORM

OPERATIONAL DETAILS

SMT's *Building Intelligence* platform collects and processes data from instrumentation located strategically throughout a structure. Complex data collected from thousands of sensors and nodes is processed and presented in a straightforward visual interface.

The SMT monitoring system can be operated in various configurations (i.e. point source, linear or grid patterns) that enable the facility or its management to be alerted of a leak and to be notified of the location in which a leak sensor has been triggered. SMT's suite of sensors is available for use in both existing structures and new construction. Our patent-pending hybrid wired and wireless data acquisition system facilitates communication in all types of building environments.

Award Winning Technology

SMT is a Finalist for the National Research Council's Industrial Research Assistance Program's (NRC-

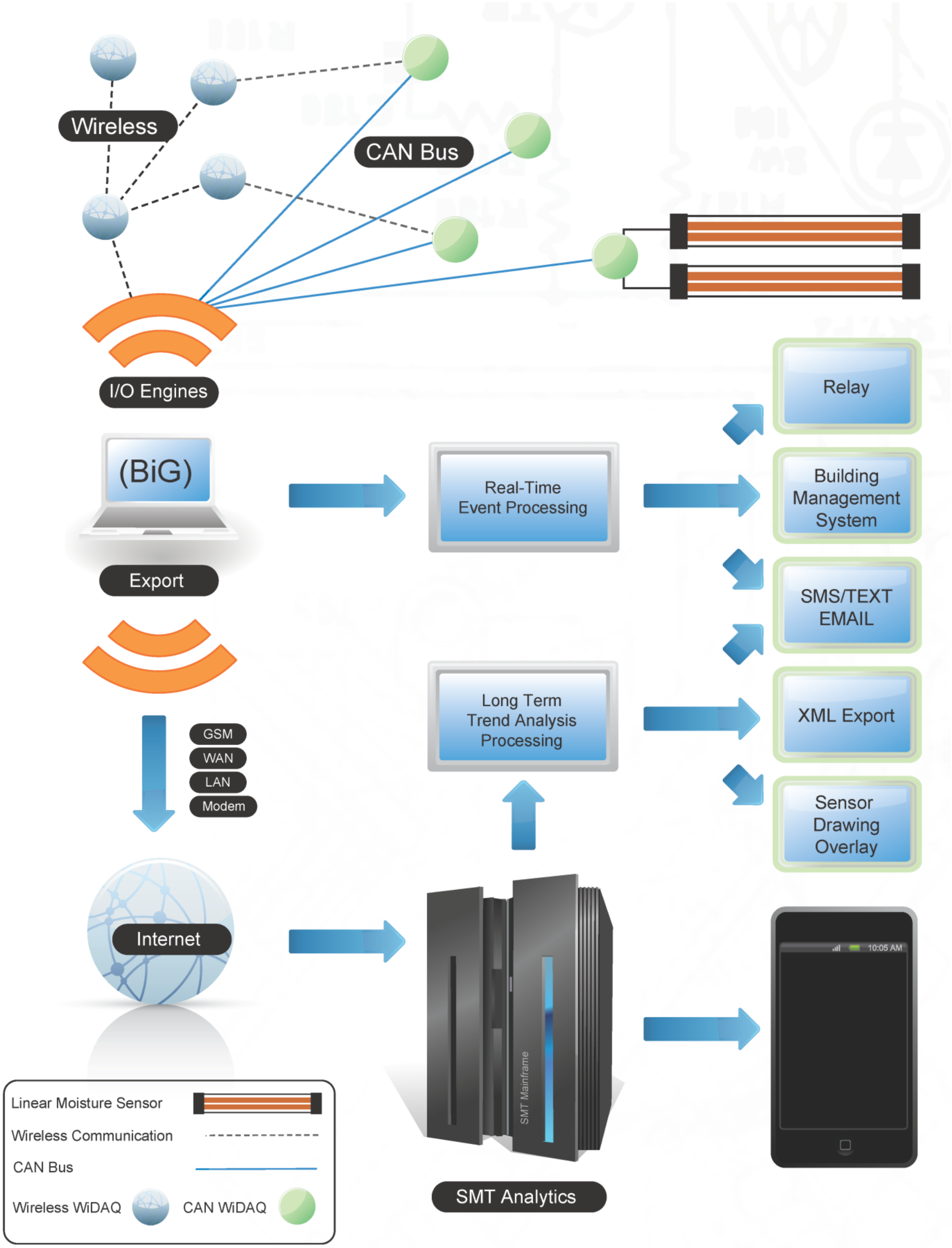
SMT's monitoring solution is employed in a variety of structures including research facilities, single-family homes, residential and commercial use towers, universities, museums, data centers, and critical utility infrastructure. Each system is tailored to the specific structural health or investigative monitoring application required at the site.

The *Building Intelligence* platform comprises four major system components as illustrated in the diagram below. Such is a representation of network architecture - components may or may not be configured exactly as shown.

1. **Sensors** – interpreting physical parameters
2. **WIDAQ** – intelligently acquiring, logging, and transmitting data
3. **Building Gateway** – local database, real time event processing, and communications platform
4. **Building Analytics** – enterprise class data processing, storage, retrieval, and presentation system

Each of the four components above is shown in the System Architecture diagram on the next page. Further details on each element are also outlined in subsequent sections.

SYSTEM ARCHITECTURE


Wireless
CAN Bus
I/O Engines
(BiG)
Export
Real-Time
Event Processing
Relay
Building
Management
System
SMS/TEXT
EMAIL
XML Export
Sensor
Drawing
Overlay
GSM
WAN
LAN
Modem
Long Term
Trend Analysis
Processing
Internet
SMT Mainframe
SMT Analytics
10:05 AM
Linear Moisture Sensor
Wireless Communication
CAN Bus
Wireless WiDAQ
CAN WiDAQ

SENSORS

A wide range of sensors are available for use with the *Building Intelligence* system. SMT designs and manufactures proprietary sensors for moisture and condensation detection linked to a detailed analytical reporting platform. A precision multichannel 24-bit analog to digital converter enables many different signaling systems to be accurately read (extended ranges available): Voltage (µV-5V), Current (µA-20mA), and Resistance (100Ω-1GΩ).

The *Building Intelligence* system is also capable of monitoring a wide range of third party sensors. Typical sensor output such as 4 –20 mA current loops, 0 to 5V, ratio metric voltage and resistance are easily read by the system. Compensation algorithms are available for non-linear sensors with multiple interdependent variables.

Available sensors for use in building instrumentation include, but are not limited to:

- Point Moisture Measurement
- Multipoint Moisture Measurement
- Linear Moisture Detection Sensor (“tape”)
- Condensation Sensors
- Relative Humidity (0-100%, condensing)
- Temperature (-50C – 150C standard, extended ranges available)
- Heat Flux and Energy Transfer
- Solar Radiation
- UV Radiation
- Differential Pressure and Flow
- Absolute Pressure
- IAQ Gas Sensors (CO, CO_2, Particulates, Volatiles, Flammables)
- Complete weather stations
- Displacement and Movement

HYBRID WIRED AND WIRELESS DATA ACQUISITION UNIT (WIDAQ)

The Wireless Precision Data Acquisition Node (WiDAQ) is a high precision measurement device designed for remote structure monitoring. The built-in 24-bit analog/digital converter and low-noise, high-precision measurement circuitry **facilitates data acquisition from a wide variety of sensors**. Energy harvesting (solar power) and extremely low power measurement and communication protocols allow for long term deployments in areas traditionally inaccessible to monitoring systems.

The hybrid wireless/wired capability of the WiDAQ offers several benefits over a wireless or wired only system. Wired nodes act as coordinators for the wireless nodes allowing wireless units to extend battery life. The wired backbone operates over a robust Controller Area Network (CAN) and permits dense sensor deployments in harsh environments.

In leak detection applications, the WiDAQ measures the linear sensor electrical characteristic when water contacts the detection tape. The monitoring system can report the following states:

- Sensor intact and not faulted.
- Sensor damaged or shorted by method other than water.
- Water present.

The unique and precise resistance range of measurement allows the system to detect shorts below 20 ohms and measure resistance up to 1 Gigaohm. Tolerances of 0.1% enable the system to accurately measure high quality precision thermistors. On board continuous recalibration and internal temperature compensation allows **SMT to offer the widest measurement ranges of any commercially available system**. In addition to precision measurement, this enables reliable fault detection, noise immunity, and compatibility with a wide range of 3rd party sensors.

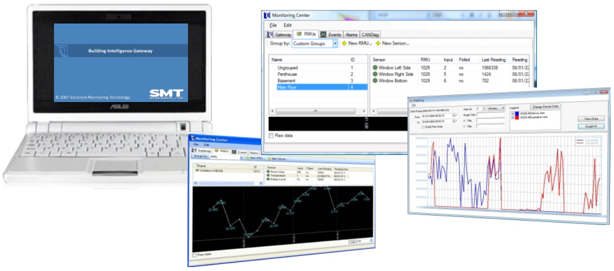
SMT's WiDAQs operate autonomously, completing a scan of all eight-resistance inputs within five seconds. A flood event is reported within seconds of detection. Each sensor provides a heartbeat signal to the local gateway at frequencies up to 1 per minute. **Competing leak detection systems depend on polling each sensor input, becoming less efficient as the system grows**. Indeed, competing systems rely on sequential polling, requiring up to 30 minutes between polling individual sensors and rely on human oversight to detect faults.

The hybrid wireless/wired capability of the WiDAQ offers several benefits over a wireless or wired only system. Most systems are permanently wired for long term monitoring using UPS protected power supplies and a robust industrial communications bus (CAN 2.0B). All wired WiDAQs have active 802.15.4 wireless transceivers. **This unique feature facilitates the addition of sensors on a temporary or permanent basis without costly additions or changes to the system** and provides multiple communication pathways should a primary route fail.

BUILDING INTELLIGENCE GATEWAY (BIG)

OVERVIEW

The Building Intelligence Gateway (BiG) is a compact yet powerful computer system used to provide continuous monitoring and data collection of distributed sensors used for automated structure monitoring. The BIG system collects data from a wide variety of sensors located within the monitored structure and provides real time event monitoring, interfaces to building management systems, local analysis of data, and distribution to a central monitoring database and reporting system.



The BiG system can be used as a gateway to SMT's *Building Analytics* online monitoring solution, or as a stand-alone system for local non-internet connected building monitoring applications. Users enjoy the familiar local and remote windows interface for manipulation of live view graphing features, as well as user defined thresholds, and alarm and event programming.

Some of the technical features of the BiG system include:

- Multiple Alarm outputs selection:
    - Directly send SMS text message to cell phone or pager, email alarm location to multiple users.
    - Trigger Dry Contact Relays for alarm notification.
    - Live XML and CSV export for incorporation 3rd party Building Management Systems interface panels.
- Automatic fall back to cell modem and/or dial up modem if primary network interface fails or is unavailable.
- Solid-state storage device and transaction logging database.
- Proven hardware platform based on Intel's Centrino and Atom architecture.
- Local graphical terminal for real-time system and alarm overview with remote access function.
- Standard TCP/IP wired 10/100 Ethernet or 802.11b/g communication to the system.
- Local interface is accessible over the local network, and also can be made available for access of internet (WLAN or VPN), through the Microsoft RDP remote control protocol.
- Self-monitoring, maintenance, and recovery systems for local database corruption.
- Built in battery back-up system for power system failures.
- Expandable memory by use of SD memory cards.
- Automatic software maintenance through SMT's auto-updater technology for the *Building Intelligence* Gateway.

INTEGRATED BUILDING SYSTEM ALERTS (OPTIONAL)

BiG can be integrated with a building automation system through the export of the data in XML format to the Building Management System. Additional export data methods may be investigated and a budget price can be provided when further identified.

DIAL-UP / INTERNET CONNECTION (OPTIONAL)

The monitoring solution for indication by SMS or text paging is dependent on a phone line or Internet connection. Additionally, the dial-up or Internet connection is for the transfer of the data back to the monitoring center and for notification to specified individuals of the alert.

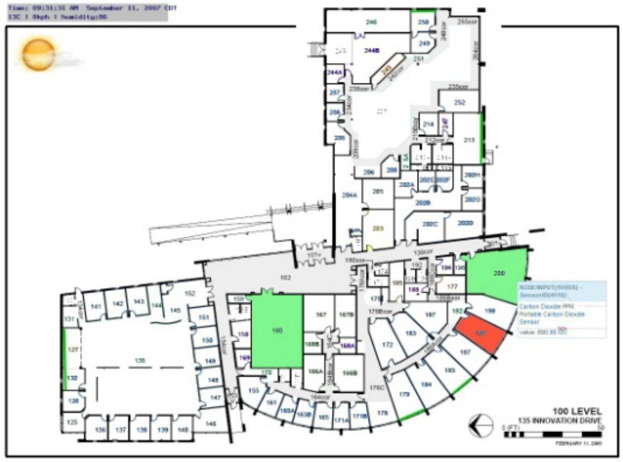
Routine updates to software and system maintenance can easily be configured by our system engineers remotely, when the access to the system can be maintained over a TCP/IP connection.

Our pricing does not include the installation of an Internet connection unless identified.

REDUNDANT INTERNET CONNECTION – CELLULAR SERVICES (OPTIONAL)

The supplied network connection or wireless Internet connection can be augmented with a cellular connection to perform SMS text pages and email alarms to off-site personnel. The cellular connection reports back to the monitoring center when there is no other communication method. SMT uses the Rogers Portable Internet (Wi-Max) and 3G cellular data network for this solution. The redundant communication method is a robust add-on to the Building Intelligence gateway but does have added cost and maintenance coefficients.

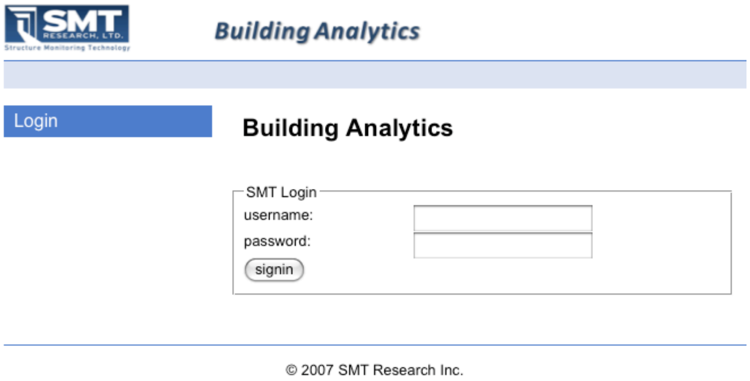
BUILDING ANALYTICS: SMT MONITORING CENTRE



SMT's *Building Analytics* monitoring center is an enterprise class transactional database system with an advanced web based front end. The system provides data collection, processing, analysis, and long-term storage of data for the *Building Intelligence* platform. Event evaluation occurs on each sensor input as data is collected so that alarms or notifications are provided without delay when values exceed thresholds.

The system provides automated reports that are emailed to users based on desired schedules and notification criteria. Reports and live access to the system are available at any time through an Internet connection and web browser.

Sensor data is overlaid on architectural plans, photos or other graphical representations of the structure. Historical graphical sensor overlay information can be replayed at high speed over selected periods to evaluate cause and effect.



Building Analytics

SMT Login
username:
password:

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Secure login from any internet-enabled computer through internet browsers such as Explorer, Firefox, Safari, and Chrome make access universal and easy.

PARAMETERS MONITORED

The *Building Intelligence* system monitors critical parameters including, but not limited to:

- Moisture intrusion from the exterior
- Moisture accumulation due to condensation
- Moisture accumulation as a result of leaks around plumbing, showers and other interior fixtures
- Flood and leak detection using point and linear sensors
- Roof leak and moisture accumulation system
- Moisture content levels of materials (direct and indirect methods):
- Interior surfaces including wood, gypsum, insulation and concrete
- Exterior walls, roofs, and foundation systems
- Condensation formation: walls, glazing, cavities, and exterior surfaces
- Temperature profiles across assemblies such as walls, roofs, or glazing units
- Pressure (differential or absolute) across walls, cavities, roofs, and the exterior
- Relative humidity in the building envelope, cavities, crawl spaces, attics, and interior
- Local weather station information including precipitation, wind speed and direction, solar radiation, barometric pressure, temperature, and humidity
- Wind speed and direction for construction safety
- Total solar radiation on building surfaces: elevations, roofs, and glazing systems
- Indoor air quality including carbon dioxide and monoxide, particulates, volatile organics, combustible and noxious gasses, and radon

COMMUNICATION AND ALERT METHODS

The monitoring system provides an alert on water detection by the following means:

- **Log on to monitoring system gateway**: users can log into the monitoring system gateway (BiG) locally in the building or remotely (pending IT security settings) for real time status of zones directly from BiG.
- **E-mail, text or SMS**: BiG forwards alerts by e-mail or text page / SMS message to individuals. Text based descriptions are augmented with framed paper plan drawings.
- **Web based access**: users can review sensor status on overlays of site photographs and as-built drawings from the building with the alert area highlighted.

A wired Ethernet network connection including one of the following: an externally routable IP address; port forwarding for 2 ports using TCP from an external IP address; or by way of external access through an SSL VPN or RDP.

TECHNOLOGY PARTNERS

SMT partners with leading technology vendors in order to provide our customers the best possible product. We have included brief profiles of a few of these vendors. Further information is available upon request.

	Partner Description	**SMT Product**
ASUS	ASUS, a technology-oriented company blessed with one of the world's top R&D teams, is well known for high-quality and innovative technology. With unyielding commitment to innovation and quality. The company is ranked as No. 1 in quality products and services by the Wall Street Journal Asia.	BiG hardware
MICROCHIP	The Embedded Control Solutions Company® Microchip is a leading provider of microcontroller and analog semiconductors, providing low-risk product development, lower total system cost and faster time to market for thousands of diverse customer applications worldwide.	WiDAQ hardware
ROGERS™	Rogers has been independently proven to be the most reliable wireless voice network in Canada. Extensive coverage and high-speed wireless access coast to coast Rogers Wireless has the largest, integrated wireless voice and data network in Canada that reaches 94% of the Canadian population.	Remote Internet Connectivity: GPRS 3G WiMax
price®	Price Electronic Development Center (EDC), specializing in all aspects of electronic design. In order to meet specific needs, the EDC team works directly with our customers to develop custom control solutions. State-of-the-art CAD design tools are used to develop schematics and printed circuit board designs. Sophisticated assembly tooling and 100% rigorous testing ensure the highest quality production	Manufacturing and Assembly in Canada
Microsoft	Microsoft is the worldwide leader in software, services, and solutions that help people and businesses realize their full potential.	BiG Software Analytics Software Development Platforms
ANALOG DEVICES	Analog Devices defines innovation and excellence in signal processing. ADI's analog, mixed-signal, and digital signal processing (DSP) integrated circuits (IC) play a fundamental role in converting, conditioning, and processing real-world phenomena such as light, sound, temperature, motion, and pressure into electrical signals.	WiDAQ

	Partner Description	**SMT Product**
FlexiPanel	FlexiPanel develops wireless ZigBee and Bluetooth solutions. FlexiPanel provides a seamless wireless integration solution. Provide and a simple path to add ZigBee or 802.15.4	WiDAQ
PELICAN™	*Pelican™ Products, Inc. is a global leader in the design and manufacture of advanced lighting systems and virtually indestructible cases for protecting valuable equipment*	Portable Kit

REFERENCES

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RCABC Guarantee Corp. (RGC)

RCABC Guarantee Corp. (RGC) Roofing Practices Manual-[Latest Edition]

RGC Guarantee Standards [E Waterproofing].